

Listing of the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (original) High-strength steel sheet excellent in hole-expandability and ductility, characterized by;

comprising, in mass%,

C: not less than 0.01 % and not more than 0.20 %, Si: not more than 1.5 %,

Al: not more than 1.5 %,

Mn: not less than 0.5 % and not more than 3.5 %,

P: not more than 0.2 %,

S: not less than 0.0005 % and not more than 0.009 %,

N: not more than 0.009 %,

Mg: not less than 0.0006 % and not more than 0.01 %,

O: not more than 0.005 % and

Ti: not less than 0.01 % and not more than 0.20 % and/or Nb: not less than 0.01 % and not more than 0.10 %,

with the balance consisting iron and unavoidable impurities,

having the Mn%, Mg%, S% and O% satisfying equations (1) to (3), and

having the structure primarily comprising one or more of ferrite, bainite and martensite.

$$[\text{Mg}\%] \geq ([\text{O}\%]/16 \times 0.8) \times 24 \quad \dots (1)$$

$$[\text{S}\%] \leq ([\text{Mg}\%]/24 - [\text{O}\%]/16 \times 0.8 + 0.00012) \times 32 \quad \dots (2)$$

$$[\text{S}\%] \leq 0.0075/[\text{Mn}\%] \quad \dots (3)$$

2. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 1, characterized by containing not less than 5.0×10^2 per square millimeter and not more than 1.0×10^7 per square millimeter of composite precipitates of MgO, MgS and (Nb, Ti)N of not smaller than 0.05 μm and not larger than 3.0 μm .

3. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 1, characterized by having Al% and Si% satisfying equation (4).

$$[\text{Si}\%] + 2.2 \times [\text{Al}\%] \geq 0.35 \quad \dots (4)$$

4. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 2, characterized by having Al% and Si% satisfying equation (4).

$$[\text{Si}\%]+2.2\times[\text{Al}\%]\geq 0.35 \quad \dots (4)$$

5. (currently amended) High-strength steel sheet excellent in hole-expandability and ductility described in ~~any of claims 1 to 4~~ claim 1, characterized by;

having Ti%, C%, Mn% and Nb% satisfying equations (5) to (7),

having the structure primarily comprising bainite, and

having a strength exceeding 980 N/mm².

$$0.9\leq 48/12\times[\text{C}\%]/[\text{Ti}\%]<1.7 \quad \dots (5)$$

$$50227\times[\text{C}\%]-4479\times[\text{Mn}\%]>-9860 \quad \dots (6)$$

$$811\times[\text{C}\%]+135\times[\text{Mn}\%]+602\times[\text{Ti}\%]+794\times[\text{Nb}\%]>465 \quad \dots (7)$$

6. (currently amended) High-strength steel sheet excellent in hole-expandability and ductility described in ~~any of claims 1 to 4~~ claim 1, characterized by;

having C%, Si%, Al% and Mn% satisfying equation (8),

having the structure primarily comprising ferrite and martensite, and

having a strength exceeding 590 N/mm².

$$-100\leq -300[\text{C}\%]+105[\text{Si}\%]-95[\text{Mn}\%]+233[\text{Al}\%] \quad \dots (8)$$

7. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 6, characterized in that;

not less than 80 % of crystal grains having a short diameter (ds) to long diameter (dl) ratio (ds/dl) of not less than 0.1 exist in the steel structure.

8. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 7, characterized in that;

not less than 80 % of ferrite crystal grains having a diameter of not less than 2 μm exist in the steel structure.

9. (currently amended) High-strength steel sheet excellent in hole-expandability and ductility described in ~~any of claims 1 to 4~~ claim 1, characterized by;

having C%, Si%, Mn% and Al% satisfying equation (8),

having the structure primarily comprising ferrite and bainite, and

having the strength exceeding 590 N/mm².

$$-100 \leq 300[C\%] + 105[Si\%] - 95[Mn\%] + 233[Al\%] \quad \dots (8)$$

10. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 9, characterized in that;

not less than 80 % of crystal grains having a short diameter (ds) to long diameter (dl) ratio (ds/dl) of not less than 0.1 exist in the steel structure.

11. (original) High-strength steel sheet excellent in hole-expandability and ductility described in claim 10, characterized in that;

not less than 80 % of ferrite crystal grains having a diameter of not less than 2 μm exist in the steel structure.

12. (currently amended) A method for manufacturing high-strength steel sheet excellent in hole-expandability and ductility, which has the structure primarily comprising ferrite and martensite and a strength in excess of 590 N/mm², characterized by the steps of; completing the rolling of steel having a composition described in ~~any of claims 1 to 4~~ claim 1 at a finish-rolling temperature of not lower than the Ar₃ transformation point,

cooling at a rate of not less than 20 °C/sec, and

coiling at a temperature below 300 °C.

13. (currently amended) A method for manufacturing high-strength steel sheet, excellent in hole-expandability and ductility, which has the structure primarily comprising ferrite and martensite and a strength in excess of 590 N/mm^2 , characterized by the steps of; completing the rolling of steel having a composition described in ~~any of claims 1 to 4~~ claim 1 at a finish-rolling temperature of not lower than the Ar_3 transformation point,

cooling to between 650°C and 750°C at a rate of not less than 20°C/sec ,
air-cooling at said temperature for not longer than 15 seconds,
re-cooling, and
coiling at a temperature below 300°C .

14. (currently amended) A method for manufacturing high-strength steel sheet, excellent in hole-expandability and ductility, which has the structure primarily comprising ferrite and bainite and a strength in excess of 590 N/mm^2 , characterized by the steps of; completing the rolling of steel having a composition described in ~~any of claims 1 to 4~~ claim 1 above at a finish-rolling temperature of not lower than the Ar_3 transformation point,

cooling at a rate of not less than 20°C/sec , and
coiling at a temperature of not lower than 300°C and not higher than 600°C .

15. (currently amended) A method for manufacturing high-strength steel sheet excellent in hole-expandability and ductility, which has the structure primarily comprising ferrite and bainite and a strength in excess of 590 N/mm^2 , characterized by the steps of; completing the rolling of steel having a composition described in ~~any of claims 1 to 4~~ claim 1 above at a finish-rolling temperature not lower than the Ar_3 transformation point,

cooling to between 650°C and 750°C at a rate of not less than 20°C/sec ,
air-cooling at said temperature for not longer than 15 seconds,
re-cooling, and
coiling at a temperature of not lower than 300°C and not higher than 600°C .